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Da Rin, M.; Nicodano, G.; Sembenelli, A.

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Public Policy and the Creation of Active Venture Capital Markets

Marco Da Rin*
Università di Torino, ECGI, and IGIER
http://web.econ.unito.it/darin

Giovanna Nicodano
Università di Torino
http://web.econ.unito.it/nicodano

Alessandro Sembenelli
Università di Torino
http://web.econ.unito.it/sembenelli

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Abstract

We assess the effectiveness of different public policy instruments for the creation of active venture capital markets. Our methodology focusses on 'innovation ratios,' defined to be the shares of high-tech, and of early stage, venture capital investments. We study a unique panel of data for 14 European countries between 1988 and 2001. We have several novel findings. First, we find no evidence of a shortage of supply of venture capital funds in Europe, a result which questions the effectiveness of the most widely used policy for fostering active venture capital markets. We also find other policies to be effective. In particular, the opening of stock markets targeted at entrepreneurial companies has a positive, large effect on the innovation ratios. Reductions in the corporate capital gains tax rate increase the share of both high-tech and early stage investment. A reduction in labor regulation also results in a higher share of high-tech investments. Finally, we find no evidence of an effect of increased public R&D spending on the innovation ratios.

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1 Introduction

Venture capital is a form of financial intermediation particularly well suited to support the creation and growth of innovative, entrepreneurial companies (Hellmann and Puri (2000, 2002), Kortum and Lerner (2000)). It specializes in financing and nurturing companies at an early stage of development ('start-ups') that operate in high-tech industries. For these companies the expertise of the venture capitalist, its knowledge of markets and of the entrepreneurial process, and its network of contacts are most useful to help unfold their growth potential (Bottazzi, Da Rin and Hellmann (2005a), Gompers (1995), Hellmann and Puri (2002), and Lerner (1994, 1995)). By contrast, when venture capital is applied to companies at a later stage of their growth, or in companies which operate in technologically mature industries, it has less of an opportunity to 'make a difference' (Michelacci and Suarez (2004)). Economics thus points to the desirability of providing an adequate share of venture investments in high-tech and early stage companies.

Such a goal has been shared by public policy, which appreciates the possibility to foster venture capital for achieving economic growth and job creation ((Bottazzi and Da Rin (2002a), European Commission (2003)). Governments around the world have been trying to replicate the success that venture capital has achieved in the United States (Megginson (2004)). These attempts absorb large sums of public money. Yet, we know very little about what policies can really help create active venture capital markets. Our study contributes a first step towards filling this gap. While we cannot evaluate both the benefits and the costs of alternative policy instruments for active venture capital markets, we can contribute a rigorous assessment of what their impact has been the recent European experience.

We start by discussing the methodological challenges to assessing the effectiveness of alternative public policies for venture capital. We propose an empirical approach which allows to minimize the risk of omitting relevant explanatory variables. This relies on the notion of 'innovation ratios.' These are defined to be the ratio of high-tech investments to total venture investments (high-tech ratio), and the ratio of early stage investments to total venture investments (early stage ratio).

These ratios are useful for methodological reasons, but also for their substantive meaning: they measure the extent to which venture capital markets are active, i.e., provide support for high-tech and early stage ventures. By looking at the innovation ratios we can better understand how policy can make venture capital markets not only larger but also more effective—i.e., better able to cater to those firms which most benefit from the support of a venture capitalist.

Economic analysis has identified several policies as potentially useful for the development of active venture capital markets. For each of them we discuss the predicted effect on the innovation ratios. First, theory suggests that innovative start-ups suffer from credit constraints, and that these constraints are more severe for high-tech and early stage firms. Such constraints may be overcome by public policies which increase the supply of funds available for early stage and high-tech investment. This would stimulate venture investments in high-tech and early stage firms, and so result in higher innovation ratios. The other relevant policies influence the innovation ratios by affecting the expected (after tax, risk-adjusted) return to new ventures. A higher expected return reduces credit rationing and so increases the innovation ratios. Taxation affects the return to investors and entrepreneurs in several ways. A lower corporate capital gains tax increases the return to investors. A lower differential between the personal tax rate and the capital gains tax rate makes leaving a job and becoming an entrepreneur more attractive. Lower corporate income taxation increases the return to both investors and entrepreneurs by increasing the present value of future (after tax) corporate income. Beyond taxation, the existence of viable exit markets for venture investments also increases the expected return to investors and entrepreneurs. Policies which result in the creation of stock markets suitable for listing entrepreneurial companies are therefore expected to increase the innovation ratios. The expected return to investors and entrepreneurs can also be made higher by policies that increase the stock of R&D, giving rise to technological spillovers, and in turn to valuable entrepreneurial opportunities. Finally, the reduction of barriers to entrepreneurship—such as restrictions to hiring and firing workers—lowers the regulatory costs to entrepreneurial activity. A rigorous, comprehensive assessment of the effectiveness of these interventions can provide useful insights to policy-makers.

We take these predictions to the data, and study the experience of 14 European countries betweeen 1988 and 2001 with a panel methodology, using innovation ratios as dependent variables. We introduce for the first time a panel dimension for several measures of taxation, for the existence of stock markets for entrepreneurial companies, and for a measure of hiring and firing restrictions in labor markets. Given the nature of our data, which come from a rather homogeneous set of developed economies, and the question we want to address, we choose to estimate 'within-country' effects. This implies that we can evaluate what governments can do to increase the innovation ratios rather than explain cross-country variation in the values of the innovation ratios.

Our results challenge the prevailing policy approach, as we do not find any evidence of a shortage of venture capital funds for European companies: an increase in the supply of funds has no effect on the innovation ratios. Rather, we find that the opening of 'New' stock markets for entrepreneurial companies has a large positive impact on both the high-tech and early stage ratios. Our panel setting thus provides support for the importance of creating exit options for venture capital, as suggested by Black and Gilson (1998) and Michelacci and Suarez (2004). Taxation also matters. In particular, a reduction of the corporate capital gains taxation has a positive effect on the innovation ratios; this supports the prediction of Keuschnigg and Nielsen (2004) that lower capital gains taxation stimulates monitoring by venture capitalists by raising the return to their effort. A reduction in hiring and firing restrictions also has a positive effect on the high-tech ratio, while changes in public R&D have no effect on it. Overall, the European experience suggests that the creation of active venture capital markets might depend on providing investors and entrepreneurs with the possibility to reap the benefits of their efforts rather than on providing them with more funds.

Our results complement and advance those of previous studies—starting with the seminal contribution of Gompers and Lerner (1998)—and put them on a firmer methodological ground.

The rest of the paper is organized as follows. Section 2 describes the challenges in estimating the effects of public policy on venture capital markets, motivates our empirical strategy and choice of policy variables, and describes recent policy programmes for venture capital markets in the European context. Section 3 describes our data. Section 4 reports our results, and is followed by a brief conclusion.

2 Assessing public policy for active venture capital markets

2.1 Estimating the effects of public policy: the challenges

Since our goal is to provide an assessment of how different policies can help create active venture capital markets, the innovation ratios form the cornerstone of our analysis. There are two reasons for this, one substantial and one methodological. From a substantive point of view, we are not interested in the size of venture capital markets *per se*, but in the extent to which a change in the size of venture capital markets translates proportionately more into early stage and high-tech investments. The ratios capture precisely this effect.

The methodological reasons for our emphasis on ratios are equally important. As it is well known (see Hellmann (1998)) estimating a structural model of demand and supply is made problematic by the unobservability of the rate of return on venture capital investments and by the difficulty in convincingly identifying variables which affect only demand or only supply. For this reason most previous studies chose to estimate reduced form equations, where the level of venture capital investment is regressed against a set of observable factors which are expected to affect both supply and demand. This estimation strategy, however, is likely to suffer from serious endogeneity problems. To see why consider the following panel data equation:

$$y_{it} = \mathbf{x}_{it}^{'}\beta + y^{'}\mathbf{d}_t + \varepsilon_{it} \quad (1)$$

$$\varepsilon_{it} = \eta_i + \nu_{it} \quad (2)$$

where y_{it} denotes a measure of venture capital investment in country i at time t, $\mathbf{x}_{it}$ is a vector of time-varying country specific characteristics, and $\mathbf{d}_t$ is a $T \times 1$ vector of year dummies with 1 in the t-th position and 0 otherwise. The error term ε_{it} consists of a country component, η_i, and an idiosyncratic term, ν_{it}. Unobservable time-varying macroeconomic effects are captured by year dummies. We then ask which genuinely time-varying, country-specific policies are responsible for the evolution of the innovation ratios, and thus for the development of active venture capital markets.

The econometric challenge is to consistently estimate β under reasonable identification assumptions. Problems here can arise for two different reasons. First, some of our explanatory policy variables are likely to be correlated with unobservable (or unobserved) time-invariant, country-level omitted variables. For instance, countries can be thought of as being characterized by different propensities to innovate, related to the structure of the economy, that evolve very slowly over time and consequently can be reasonably assumed to remain constant over our sample period. In turn, these propensities are likely to be correlated both with the level of venture capital investment and with at least one of our policy variables, namely the stock of public R&D capital. Analogously, countries may have different, and relatively constant, preferences for the level of public spending. In turn, these preferences are likely to be correlated with those tax rates which the theoretical literature suggests to be important determinants of the demand and the supply of venture capital. Since these preferences are also likely to affect the level of venture capital, for instance because of a crowding out effect between public and private spending, their omission is expected to make standard least squares estimation techniques biased and inconsistent.

To overcome this first source of endogeneity it is standard practice to apply the so-called 'within-group' transformation. We then use country fixed effects to identify unobservable time-invariant factors such as legal origin or the industrial specialization of individual countries. This estimation technique allows us to consistently estimate β in the presence of time-invariant omitted variables that can be arbitrarily related to the observables.

The second problem is that the identification of structural effects through regression coefficients in deviations from country specific means (i.e. the within-group transformation) requires the lack of correlation between the regressors and the idiosyncratic error term at all leads and lags. This strict exogeneity assumption rules out the possibility that current values of some of the explanatory variables are correlated with present and past idiosyncratic errors. This is unlikely to be the case in the framework defined by (1) and (2) when y_{it} is the level of venture investments in country i at time t. In this case the idiosyncratic component of the error term includes unobserved time-varying factors like national reforms in product and factor markets which are likely both to affect the level of venture capital investment and to be jointly determined with our explanatory variables.

The textbook solution to this second source of endogeneity is to find convincing external instruments, clearly an objective almost impossible to achieve in multivariate cross-country regressions. An alternative strategy, that we adopt in this paper, is to use ratios instead of levels as dependent variables. Looking at ratios instead of at levels contributes to the solution of this endogeneity problem to the extent that the omitted time-varying country-specific explanatory variables equally affect the two components—high- versus low-tech, early versus late stage—of total venture capital investment which enter the innovation ratios.

2.2 Motivating the choice of policy variables

Imperfections in capital markets are an important reason for public intervention. In the context of venture capital innovative firms are likely to suffer from credit constraints because they have little collateral, as formalized in Holmstrom and Tirole (1997). Their model extends to the double moral hazard framework—typically used in models of venture capital financing—the seminal contribution of Stiglitz and Weiss (1981) on credit rationing. Financing of companies with low collateral requires monitoring, which reduces entrepreneurial private benefits and thus increases entrepreneurial effort. Low collateral firms would be rationed by arms' length lenders, unless they obtain finance by venture capitalists. However, this form of intermediation is more expensive, since monitoring is a costly activity. Therefore, in equilibrium, low collateral firms pay a premium on the funds they borrow; moreover, companies whose collateral is below a certain threshold cannot even obtain finance, since they need to borrow such a large amount that they would be unable to service it.[1] In this context, an increase in the supply of funds reduces the interest rate, making funds affordable for low collateral companies. Similarly, an increase in the expected (risk-adjusted, net of taxes) return on investment makes funding of high-collateral companies acceptable by arm's length financiers—even without monitored co-financing by venture capitalists—thus freeing up venture funds for low collateral firms. In both cases the innovation ratios increase. With binding credit constraints, we would then find that investment in low collateral firms—and therefore the innovation ratios—responds to policy instruments affecting both the supply of funds and investment expected return.

A simple extension of the model by Holmstrom and Tirole, available from the authors upon request, shows that there may be excess supply of venture capital funds together with credit rationing of low collateral firms because their expected rate of return does not cover the venture capitalist's monitoring costs.[2] In this context, more funds do not stimulate investment in low collateral firms, and we expect both innovation ratios to remain unaffected by an increase in the supply of funds: more funds are simply going to be invested by venture capitalists in mature firms.

On the contrary, policy instruments that affect the return to investment should influence the innovation ratios irrespective of credit constraints. When the (after tax, risk-adjusted) return on investment increases, it allows companies with less collateral to gain access to external finance, thus stimulating the innovation ratios. The first such instrument is taxation. Taxation has long been pointed to as a driver of both entrepreneurship and venture capital investment (Poterba (1989a,b), Gompers and Lerner (1998)). Different theories look at the effect of alternative forms of taxation on the demand and supply of venture funds. A relevant portion of the return to investment accrues to entrepreneurs and venture firms in the form of capital gains, when the company is either sold or floated on the stock market. A reduction in the personal capital gains tax rate should then stimulate the demand of venture funds by entrepreneurs (Poterba, 1989a,b); by the same reason, a reduction in the corporate capital tax gain should stimulate the supply of venture funds by industrial companies and institutional investors. Moreover, a reduction in the corporate capital tax rates augments venture capitalists' incentive to exert effort in monitoring entrepreneurs (Keuschnigg (2004), Keuschnigg and Nielsen (2004)), raising the success rate of venture-backed firms and therefore their expected return. The latter effect is especially relevant for public policy since venture capitalists' effort is likely to be under-provided, because she bears all the monitoring costs but shares with the entrepreneur the revenue gains generated by her monitoring services (Keuschnigg and Nielsen (2003)). Therefore, a reduction in the (personal or corporate) capital gains tax rate is expected to increase

[1] The large empirical literature on credit constraints at firm level documents that high-tech companies have limited funding (see for example Carpenter and Petersen (2002), Hall (2002), and Guiso (1998), and the references cited therein).

[2] The existence of excess supply of venture capital may not be unrealistic, since there is evidence pointing to a 'money chasing deals' phenomenon in both the 1980s and 1990s in the U.S. (Gompers and Lerner (2000), Kaplan and Stein (1993)).

the investment in high-tech and early stage companies, thus leading to an increase inthe innovation ratios.

The relative strength of demand and supply effects also depends on the structure of tax exemptions. For instance, in the U.S. the effect of a reduction in taxation is expected to be larger for the demand than for the supply because institutional investors in the U.S. are tax exempt (Gompers and Lerner (1998)). This is also the reason why the empirical literature has mainly focussed on the personal capital gains taxation. Looking at European data suggests instead to focus on the corporate capital gain tax rate, since the providers of funds are typically incorporated and taxed (EVCA (2003)).

The demand for venture funds is also linked to the personal income tax rate, which constitutes the second effect of taxation that we explore. Since entrepreneurs receive most of their return in the form of a capital gain, we expect a larger number of workers choosing to become entrepreneurs when the difference between the (marginal) personal income and capital gains tax rates increases, a point first advanced by Poterba (1989b).

The amount of the capital gain itself is affected by the discounted value of future tax liabilities at the time of the sale of the company. A higher corporate income tax rate will thus reduce investment in high-tech and early stage companies through its effect on net project return. By the same token, it will also reduce the provision of monitoring services by venture capitalists. Also in this case, the effect of a change in taxation will be larger the larger is the expected (gross-of-tax) capital gain, so that a reduction in taxation should increase the innovation ratios.

An additional effect one should consider is that of loss carry-forward provisions. These provisions allow companies to deduct present losses from future taxable income. By decreasing the potential loss, they may encourage risk-taking and therefore the demand for venture capital from high-tech and early stage companies. Such effect is more likely to fall on early stage companies, so that one would expect it to be more relevant for the early stage ratio.

Beyond taxation, theory suggests other factors as likely to influence the innovation ratios through their influence on the return on investment. The opening of stock markets suitable for listing entrepreneurial companies reduces flotation costs for entrepreneurial firms, as argued in the model developed by Michelacci and Suarez (2004). Lower flotation costs, in turn, determine an increase in the rate of business creation. When only stock exchanges for mature firms are available, the expertise of the venture capitalist is 'held up' for longer in a given entrepreneurial firm, because flotation costs decrease as the firm accumulates a track record. Since venture capitalist's expertise is a scarce resource with a fixed supply, the reduction of flotation costs allows to free up such expertise earlier. Moreover, exit by listing provides a higher return to entrepreneurs and investors than the sale to an established firm—a fact documented by Brau, Francis and Kohers (2002) and Gompers and Lerner (1997). We then expect both innovation ratios, and especially the early stage ratio, to increase following the opening of a stock market for entrepreneurial companies.

Policy can spur venture capital markets also by helping create new entrepreneurial opportunities. A large literature documents and explains the existence of positive spillovers due to expenditure in research and development (R&D). When there are spillovers in

R&D, past inventions raise the productivity of research today, increasing the return to start-up investment (e.g., Aghion and Howitt (1998), Romer (1990)). Recent empirical studies confirm that R&D spillovers can be quite large (Jones and Williams (1998), and references therein).[3] Looking at U.S. sector-level data, Hirukawa and Ueda (2003) even argue that, at the aggregate level, it may be innovation activity to lead the development of venture capital, and not *vice versa*. Gompers and Lerner (1998) also emphasize the role of R&D expenditure in the development of the U.S. venture capital industry.

On these bases, we expect an increase in the stock of R&D to translate into a higher return for new ventures. This will stimulate both the demand and the supply of venture capital. It will also stimulate the innovation ratios to the extent that the spillover effects are stronger for the creation of new companies (as opposed to the growth of existing ventures) and for technologically advanced industries (as opposed to mature ones).

Finally, entrepreneurship depends on the legal and regulatory environment, which is largely determined by public policy. While our conceptual understanding of the entrepreneurial process is still rudimentary, recent advances have shown the importance of legal and regulatory aspects. For instance, different forms of protection of property rights induce different entrepreneurial behavior (Anton and Yao (2002), Baccara and Razin (2004)). The design of bankruptcy and of labor markets also affects the incentive to become an entrepreneur (Gromb and Scharfstein (2002), Landier (2002)).[4] We would then expect a reduction in legal and regulatory barriers to entrepreneurship to increase the (after tax, risk-adjusted) expected return to creating high-tech and early stage companies, which should in turn increase the innovation ratios.

Which of these different policy approaches, if any, receive support from the data is however unclear. Our study contributes to their evaluation by assessing their effectiveness in raising the innovation ratios.

2.3 Public policy for active venture capital markets in the European context

After motivating our choice of policy variables it is useful to discuss the European context which provides the background for our analysis. Europe provides a particularly interesting environment in this respect, since its venture capital markets have developed only recently, and have been the target of several important policy initiatives. Until the early 1990s, there was very little venture capital activity in Europe, but this has substantially grown in the second half of the decade (Bottazzi and Da Rin (2002a)). While never reaching the absolute or per capital level of the U.S., European venture capital has also experienced a less pronounced fall in fund-raising and investments at the turn of the century (Bottazzi and Da Rin (2004)). The share of early stage and high-tech investments has also increased

[3] Consistent with this view, Feldman and Lichtenberg (1997), using European data, find that a country's private companies specialize in the same scientific fields as its universities and public R&D organizations.

[4] Ideally, we would like to include a country-specific, time-varying measure of the leniency of bankruptcy laws. Unfortunately such a measure is not availabe. Only in 2003 has the European Venture Capital Association started collecting systematic, albeit qualitative, data on bankruptcy.

over time, moving closer to the U.S. pattern. Still, Europe remains a quite different environment for venture capital. For instance, there are stronger differences in the legal and regulatory environments across European countries then across U.S. states. Even more importantly, European venture capital relies more heavily on banks than on institutional investors. A good third of the funds come from banking sources, and about 20% of the venture capital firms are bank subsidiaries. Moreover, venture capital firms remain considerably less numerous than in the U.S., despite a reduction in the gap during the mid 1990s. As a result, European venture capital markets still have to reach the maturity of the U.S. markets. Therefore, the policy experience accumulated in Europe over the last decade constitutes a valuable experimental ground from which many emerging markets can learn about the effectiveness of alternative policies.

The main policy initiatives in Europe have been targeted at the increase of the supply of funds for new ventures.[5] The European Commission made the increase of the supply of risk capital one priority of its policy towards innovation and capital markets (European Commission (1998, 2003)), and in 2001 it transformed the European Investment Fund (EIF) into Europe's largest venture investor with an injection of more than 2 billion euros (EIF (2002)). The Risk Capital Action Plan adopted by the European Commission in 1998, subscribed to this view and greatly influenced national policies in the late 1990s (European Commission (1998)). This approach is shared by many national programmes, from Germany's federal and regional schemes for innovative companies (German Federal Ministry for Economics and Technology (1999)), to the French 'Plan Innovation' (French Ministry of Industry (2003)), to the transformation of the Danish Growth Fund into a public venture fund in 2001 (Danish Growth Fund (2003)), and to the creation of the UK High Technology Fund (HM Treausury (2003)).[6]

Other policies have also been tried out in Europe. Several forms of taxation have undergone a broad trend towards reduction (EVCA (2003)). For example, investment vehicles with a favorable taxation have been introduced in 1995 in the UK ('Venture Capital Trust') and in 1997 in France ('Fonds Communs de Placement dans l'Innovation'– FCPI). Reductions in effective taxation have also been enacted in Germany (1998 and 2000), the Netherlands (1996), Spain (1996 and 2001). Corporate and personal income tax have also been reduced (European Commission - DG Enterprise (2002)).

The creation of 'New Markets' for the listing of entrepreneurial companies in several countries provides an interesting experiment for the evaluation of this type of policy (Bottazzi and Da Rin (2002a)).[7]

[5] Interestingly, while venture capital was born in the U.S. out of private initiative, its expansion benefited from the Small Business Innovation Research programme in the 1980s (Gans and Stern (2003), Lerner (1999)). This programme, which invested several billion dollars, was largely motivated by the fear that insufficient financing was available to innovative small firms.

[6] Public programmes aimed at increasing the supply of venture capital have also been implemented in several emerging economies, from Chile to India (Carter, Barger, and Kuczynski (1996), Gilson (2003), Lerner and Schoar (2005)). In Israel, the Yozma programme, started in 1992, provided 100 million dollars of public funding to attract private funds for over 150 millions (Avnimelech and Teubal (2002)). Yozma helped create ten private venture capital firms and to jump-start a successful and active venture capital market.

[7] Notice that the creation of 'New' stock markets started in 1997 and was completed by 1999 in most

The increase in R&D expenditure has become a priority of European governments in the last decade. The Barcelona European Council of March 2002 set the objective to increase the average investment in R&D in Europe from 1.9% to 3.0% by 2010, of which two thirds to be funded by the private sector (European Commission (2002)).

Policies aimed at improving regulatory design have been part of a broad trend towards deregulation in Europe over the 1990s, as documented in a series of OECD studies reviewed in Nicoletti and Scarpetta (2003). In particular, several countries have made an attempt to reduce regulatory barriers to entrepreneurship, with results which have been favorably assessed by recent empirical analyses (Alesina et al. (2005) and Klapper, Laeven, and Rajan (2004)).

3 The Data

3.1 Data sources and description

Our analysis is based on a panel of data gathered from several sources. We consider data for the following 14 European countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, and the UK over the years between 1988 and 2001.[8]

3.1.1 Dependent variables

Our source for the dependent variables is the European Venture Capital Association (EVCA), whose yearbooks are compiled from an extensive yearly survey of member and non-member firms.[9] For each year and country, we look at the reported amount of total investment. This is divided into five categories: seed, start-up, expansion, replacement capital, and buyouts. We define venture capital (VC) to be the sum of the first four categories, and non-venture private equity to equal the last one. The sum of venture and non-venture private equity investments is referred to as (total) private equity (PE). We then partition venture capital investments into early stage (ES)—equal to the sum of seed and start-up investments—and late stage (LS)—equal to expansion investments and replacement capital.

We define high-tech investments (HT) as the sum of investments in the following sectors: communications, computer related, other electronics related, biotechnology, medical and health related. Low-tech investments (LT) are investments in the remaining sectors:

countries. As our descriptive statistics below make clear, this should dispel concerns for endogeneity, since the opening of these markets predates the increase in supply of venture capital which took place starting from 1998.

[8] We do not include in our analysis the US in order to avoid measurement errors. While the US constitute the world's largest private equity market, the venture capital data collected by the National Venture Capital Association (NVCA) are coded with different definitions than those of the EVCA.

[9] For details on the EVCA database see the methodology section of EVCA (2001).

energy, consumer related, industrial products and services, chemicals, industrial automation, other manufacturing, transportation, financial and other services, agriculture, and construction. All sums are expressed in millions of year 2000 euros. Finally, we define the two innovation ratios: the High-Tech Ratio is the ratio of HT to PE, and the Early Stage Ratio is the ratio of ES to VC.[10]

3.1.2 Independent variables

Our measure of the funds raised by venture capital firms is the total amount of funds raised from all sources by a country's private equity firms in given year.[11] We express all values in euros, using the synthetic euro exchange rate of Datastream for the conversion. From Datastream we also download population and price indices for all countries. We use population to express values in per capita terms, and price indices to obtain constant 2000 values.

Our next set of variables is built from five different tax rates. Based on the above discussion, we consider the following taxation variables. To capture the effect of capital gains taxation we consider the corporate capital gains taxation. To consider how relative taxation affects the decision to become an entrepreneur, we consider the difference between the personal income taxation and the personal capital gains tax rate. To consider the effect of corporate income taxation on the present discounted value of the (expected) capital gain, we consider the corporate income tax rate. Finally, we examine a synthetic measure of the generosity of loss carry-forward provisions. We obtain our measures of capital gains taxation from two sources, both published by Ernst&Young, a leading tax consulting firm. Country information is compiled by Ernst&Young local offices, which ensures high professional standards and consistency, both over time and across countries. The first source is the *Worldwide Corporate Tax Guide*. Each year, the *Guide* reports for over 140 countries the main corporate tax rates. From the *Guide*, we take the corporate capital gains tax rate and the (marginal) corporate income tax rate. We also take information about loss offset and loss carry-forward provisions. The second Ernst&Young source we use is *The Global Executive*, a guide to the taxation of executives in over 130 countries. From this yearly source we obtain the (marginal) personal tax rate and the (marginal) personal capital gains tax rate.

Our measure for the exit opportunity for venture investments is the existence of a stock market suitable for entrepreneurial companies, since several European countries opened such trading segments within their stock markets during the 1990s (Bottazzi and Da Rin (2002b)). For all European 'New' stock markets we obtain the date of opening from the respective stock exchanges, and use a dummy variable which takes value 1 when a stock

[10] Ideally, we would like to be able to measure the High-Tech Ratio as the ratio of HT to VC. A limitation of the EVCA data is that they do not provide a separate sectoral disaggregation for venture and non-venture private equity.

[11] Note that while funds invested are recorded according to which countries they go into (the 'country of destination' criterion), funds raised are recorded by the country where the venture firm is based (the 'country of management criterion,' see EVCA (2001)). Baygan and Freudenberg (2000) discuss the importance of cross-border capital flows, which in Europe—while increasing over time—remain relatively small.

market for entrepreneurial companies is available and 0 otherwise.

To measure the arrival of entrepreneurial opportunities, we use the amount of public R&D expenditure. From the OECD Main Science and Technology Indicators database we obtain yearly data on country-level total research and development (R&D) expenditure, business and government R&D, and R&D in higher-education. We measure R&D spillovers with the standard perpetual inventory methodology, which we describe in the Appendix.

We collect our measure of the 'hiring and firing' barrier to entrepreneurship from yearly issues of the *World Competitiveness Yearbook* compiled since 1989 by the IMD business school. The *Yearbook* provides 241 country-level quantitative and qualitative measures of competitiveness assembled from public data and surveys of local business leaders in 60 countries. From the *Yearbook* we obtain data on the flexibility of hiring and firing practices. Table 1 provides the definitions of all the variables we use in the analysis.

3.2 Descriptive statistics

We start exploring our data by looking at descriptive evidence. In Table 2 we notice that less than a quarter of venture capital investment goes to early stage projects, and less than a third of the total private equity investments is in high-tech.

Two Figures look at the evolution over time for the aggregate of the 14 countries we consider. Figure 1 plots the innovation ratios, and Figure 2 the total supply of funds into private equity. The sharp upturn in the supply of funds starting in 1996 and its equally sharp fall since 2001 is mirrored in a sharp drop in the innovation ratios. At first sight, this seems to suggest that the supply of funds may in fact pose a binding constraint on investment, and seems to provide evidence of a positive relationship between the supply of private equity funds and the innovation ratios. In our regressions we ask whether this visual evidence can be given a structural interpretation or not.

For each country, Figure 3 reports 3-year moving averages of the innovations ratios, which provide further evidence of the pattern shown by Figure 3. For both ratios, we notice some variability across countries. While such cross-country variability naturally asks for an explanation, the nature of our data suggests to explore the time dimension of the data and control for country-specific factors as discussed in Section 2.1.

4 Regression results

4.1 Main results

We address the effectiveness of different policies by estimating several versions of the panel equations (1) and (2).Our main specification contains the following explanatory variables: our dummy measure for the opening of stock markets of entrepreneurial companies, measures of taxation, the stock of public R&D, the measure of barriers to entrepreneurship, and the supply of funds into private equity.

Our choice of taxation variables requires some further comment. In Table 3 we present pairwise correlations for the corporate capital gains tax rate (CGT_{it}), the difference between the (marginal) personal income tax rate and the personal capital gains tax rate (DIT_{it}), and the corporate income tax rate (CIT_{it}).[12] The two measures of corporate taxation turn out to be highly correlated. This is not surprising since Europe has seen a trend towards lighter taxation in the last decade, which also involved lower personal income taxes. Such correlation suggests that we avoid using both corporate tax rates in our regression. We choose to use the corporate capital gains taxation, and consider the corporate income tax rate in an extension we discuss in Section 4.2. While this strategy prevents us to make full use of our dataset, it delivers more reliable estimates.

We normalize all the measures of investments, the stock of public R&D (RD_{it}), and the supply of funds (SF_{it}) by the population in country i at year t in order to abide by the strict exogeneity assumption. Using gross domestic product in the regression, a common practice in the literature, would violate the assumption. By the same reason, we construct the stock of R&D using only public expenditure, since private ('business') expenditure would also violate strict exogeneity; and we refrain from using patents as a measure of innovation and the number of IPO listings as a measure of the availability of an 'exit' for venture investments.

Results from the estimation of this specification are presented in Tables 4 and 5. Each Table refers to a specific innovation ratio, and reports estimated coefficients together with the corresponding standard errors. Since (unreported) time dummies are included in all equations, our estimates genuinely pick the effects of changes in our explanatory variables. For example, the effects of the availability of a 'New' stock market targeted at entrepreneurial companies are captured beyond a common cyclical trend.

Our main results can be summarized as follow. We find consistent evidence that policy can contribute to the creation of active capital markets, but that not all policies are effective. Three types of policy have an effect on the innovation ratios: the corporate capital gains taxation, the opening of 'New' stock markets, and the reduction of barriers to entrepreneurship.

First, increases in the corporate capital gains tax rate have a consistently negative effect on both innovation ratios. The economic effect of an increase in the capital gains tax is positive and large: moving the marginal tax rate (CGT_{it}) from the lower tail (25th percentile) to its higher tail (75th percentile) decreases the high-tech ratio by about 0.065 (or 22%). The tax incentive to remain an employee rather than become an entrepreneur has a positive, and insignificant, effect on the high-tech ratio in the more general specification; however it becomes significant when we do not include the capital gains tax rate. One possible interpretation is that the positive correlation among tax rates captures a broad trend whose precise effects we may not be able to capture. The effect on the early stage ratio has the same sign but is estimated imprecisely.

Second, we find the opening of a 'New' market to have a positive and significant effect on both the early stage and the high-tech ratios. The economic effect in this case is also noticeable, as the opening of a 'New' market raises both innovation ratios by about 10%.

[12] We deal with loss carry-forward provisions in the next Section, since its measurement requires some further assumptions.

This result is consistent across all our specifications and conforms to our predictions. It also suggests a sobering approach to the critiques of the recent experience of the 'New' stock markets, which often focus on the issue of losses to individual investors. Our results provide a more positive perspective by stressing the importance of this exit option for active venture capital markets.

Third, a reduction of the barriers to entrepreneurship ('hiring and firing' restrictions) turns out to be positive and statistically significant in most specifications for the high-tech ratio. This effect is also economically large: moving the hiring and firing measure from its 25th to its 75th percentile raises the high-tech ratio by 0.075 (or 26%).

Another notable result is that, in all reported equations, the supply of funds is never statistically different from zero. This holds for both innovation ratios; it is also robust to several alternative definitions of the supply of fund and specifications that we describe in the next section. Therefore we do not find evidence supporting the 'limited supply' of venture capital hypothesis in Europe during our sample period which has inspired so many policy initiatives.

Finally, the stock of public R&D capital is found to have a negligible, statistically insignificant, effect on the innovation ratios.[13] This suggests that increasing public R&D does not result in a higher return for early stage or high-tech entrepreneurial ventures.

4.2 Extentions and robustness checks

In this Section we extend our results, especially by delving more deeply into the lack of evidence for a role of the supply of funds, and address several methodological concerns. First of all, we explore different definitions of the supply of funds, and report our main extensions in Tables 6 and 7. Column *(i)* of both Tables take care of the fact that the funds raised by venture capital companies in one particular year are not necessarily invested in the same year (Gompers and Lerner(2000)). This may suggest that our baseline static model suffers from a dynamic misspecification problem. To address this additional concern we rerun all our equations after including the once lagged variable, SF_{it-1} to the original specification. While we lose some observations due to the use of a lagged variable, this does not alter significantly our overall results.

A second extension is suggested by the fact that the 'bubble years' of the late 1990s might have been characterized by an excess supply of funds, while the previous period by a shortage of funds. Our results in Tables 4 and 5 might therefore suffer from pooling together two different regimes. Column *(ii)* of Tables 6 and 7 report our results, where we identify the 'bubble' years with 1997 through 2000. We find no evidence of a different role of the supply of funds in these two sub-periods.

Another possibility we want to examine is that countries may experience a different effect of the supply of funds depending on the stage of development of their venture capital markets. Arguably, countries where venture capital markets are less developed may also experience a lack of professional expertise which might have an adverse effect on the

[13] As a check on the robustness of this result, we also use the stock of total R&D, which includes private (business) R&D, despite the fact that it clearly fails the strict exogeneity requirement.

innovation ratios. We define 'developed' to be a country with a (per capita) supply of funds higher than the median at the start of our panel (1988).[14] Column *(iii)* of Tables 6 and 7 reports the results of a specification where we allow for a different effect of the supply of funds depending on the development of a country's venture capital markets. With this equation we explore the possibility that a limited supply of venture capital is more likely to be found in countries with a less mature venture capital markets. This extension has no effect on our estimates.[15]

We have chosen not to use the corporate income tax rate in the main specification for its correlation with the corporate capital gains tax rate. When we modify our specification and use the former tax rate instead, we find similar (though somewhat less precisely estimated) results.

We have not included loss carry-forward provisions in the main specification. This is because obtaining a measure of these provisions requires some additional assumptions. First, there are sometimes limfits on the losses a company can carry forward.[16] More importantly, sometimes there is a short time limit on such provision and sometimes there is no limit. One then needs to make an assumption on how to measure such 'infinite' carry-forward provisions. We build a measure of the generosity of loss carry-forward provisions equal to the number of years a loss can be carried forward. When there is no limit, we put a value of ten, equal to the maximum (finite) limit within our sample. If we include such (admittedly crude) measure in our regressions, this turns out to have no effect on the innovation ratios, and our main results are not affected. One possible reason for the ineffectiveness of this policy is its lack of variability—most countries have at most one change in the measure over the sample period. Loss offset provisions, which allow a refund of past tax liabilities for companies with current losses, may also affect the innovation ratios. Here as well we need to make some additional assumption. We categorize this variable by the number of years it allows go back. The minimum number of years is zero and the maximum is three. When we add our loss offset provision our results do not change, and the measure itself has no explanatory power.

We then turn to several possible methodological concerns, for which we estimate, but do not report, additional variations of our basic specification.

First, our findings might not be robust to alternative definitions of our variables. In particular, it might be argued that the replacement capital component should be excluded from venture capital investment. This, in turn, would alter the denominator of the Early Stage Ratio. To address this concern we rerun all our reported equations after redefining the Early Stage Ratio. Our findings are virtually unaltered. The same happens when we modify the supply of funds variable to include realized capital gains.

Another concern regards the role of different components of the supply of funds. To

[14] The countries which turn out to have a relatively less mature venture capital equity industry in 1988 are Austria, Belgium, Finland, Germany, Greece, Italy, Portugal and Spain.

[15] In unreported regressions, we also check that this results does not change if we allow a country to switch every year between 'developed' and 'not developed.'

[16] In most country-years there are also limits to the application of such provisions in case the company is acquired. This is done to avoid generating an artificial market in loss-making companies which may result in tax elusion.

this purpose we disaggregate the sources of funds.[17] Such disaggregation is intuitively appealing, but it is methodologically questionable, since leaving out some components of the supply of funds introduces an additional source of omitted variables problem. First, we single out funds supplied by institutional investors (insurance companies and academic institutions). It can be argued that these investors instruct venture fund managers to comply with well defined objectives (Mayers, Schoors, and Yafeh (2002)), given their longer run perspective than other investors. When we isolate these funds, we do not find any significant changes, and the significance of this variable is far from any acceptable level. Similarly, we explore in our context the result of Gompers and Lerner (1998) on the role of pension funds. They show that the clarification of the 'prudent man rule' in the context of the Employment Retirement Income Security Act brought to a surge of pension fund investments in venture capital. To date, pension funds remain the largest single source of venture capital in the U.S. (NVCA (2003)). Several countries in Europe began reforming the structure of their social security system from pay-as-you-go to funded in the 1990s. As a consequence, the financial assets of pension funds have increased. Since these institutions are allowed to invest in venture capital, as long as adequate diversification is maintained, their funding of venture capital has increased. However, when we isolate the supply of venture capital which comes from pension funds we find no evidence of a distinct role of pension funds.

The other important component of the supply of funds we isolate is government funds. These constitute the direct policy instrument for increasing the supply of venture funds. Arguably, the government may be more interested in the creation of long-run growth opportunities than the maximization of its profits, so public funds can be expected to be particularly targeted at high-tech and early stage companies. We have not focussed on these funds in the main text because of the methodological concern discussed in the previous paragraph, which makes the total supply of funds a sounder explanatory variable. Still, if we look at the effect of government funds alone, we do not obtain any different results.

We have used two different denominators for the innovation ratios. Data limitations have forced us to use in the High-Tech Ratio the amount invested in private equity and not only in venture capital. To ensure that our results are not affected by the choice of denominator, we also estimate the early stage ratio with the same denominator, and we find that the results are not sensitive to this change.

An important assumption in our analysis so far has been that the presence of a New stock market is by itself sufficient to affect the innovation ratios—i.e., that investors are always willing to buy shares of companies which go public. However, it is well know that the markets for Initial Public Offerings (IPOs) experience cycles which bring them over waves of 'hot' or 'cold' investor appetite. In other words, the sheer availability of a stock market may by itself not be enough to stimulate venture investment. To explore this possibility we introduce in the analysis a panel of stock market indices. For each country, we obtain from Datastream the yearly average of the MSCI (Morgan Stanley Capital International)

[17] The EVCA data breaks the sources of funds into the following categories: realized capital gains, corporations, individuals, government agencies, banks, pension funds, insurance companies, funds of funds, academic institutions, capital markets.

stock market index for the main stock market. We take the MSCI index to be a measure of investors' appetite for stocks of entrepreneurial firms. Notice that we employ the MSCI index for the main market rather than for any 'New' market—or the number of IPOs in the current or previous year—in order to abide by the strict exogeneity condition. We then estimate a set of equations where we include the MSCI index as an explanatory variable. We introduce this variable both with an additive and a multiplicative term. In either case, this variable is not significant, and its inclusion does not affect the magnitude or significance of the coefficient for the New markets.

An important concern is that the real bottleneck is not money but people. Michelacci and Suarez (2004) do stress the human factor in financial intermediation, whose empirical importance is documented in Bottazzi, Da Rin, and Hellmann (2005b). To address this issue, we construct a variable consisting, for each country and year, of the number of venture capital firms which are members of the European Venture Capital Association. We then use this variable in alternative to the supply of funds. The resulting estimates confirm our main results by not showing any sign of a shortage.

One specific concern can be raised in relation to the Early Stage Ratio. It is well known that venture-backed companies typically receive staged financing (Gompers (1995)). This means that the company will receive funds over several rounds across a few years. Since the company would then progressively mature from the seed or start-up stages to later stage deals there is clear suspicion that the figures for late stage financing simply reflect 'life-cycle' effects and not investment decisions by the venture capitalists. We can control for this important observation by including in our regressions for the early stage ratio the lagged value of the absolute amount of early stage investments. We are comforted by noticing that our results are unchanged.

Finally, one could be concerned that our results are driven by a single country. We discard this possibility by re-running our regressions excluding one country at a time. Overall, therefore, our results appear to be consistently robust to a wide variety of checks.

4.3 Relating our results to previous studies

While we have proposed an innovative methodology for analyzing the role of public policy in creating active venture capital markets, we also want to relate our results to those of the extant literature. To this purpose, in Tables 8 and 9 we report estimates of equation (1) where the dependent variables are levels of venture capital investments. In Table 8 we report estimates for high-tech and low-tech investments, and in Table 9 for early stage and late stage investments. While these estimates are likely to suffer from the methodological problems we discussed in Section 2.1, they are useful for relating our own findings to those of previous studies.

The results for level estimates are broadly consistent with previous studies, and also with our results for the innovation ratios. Corporate capital gains taxation turns out to have some effect on the level of high-tech and early stage venture investments. In particular, lower taxation provides an incentive to invest more in high-tech and early stage projects rather than in low-tech and late stage. This result corroborates that by Gompers and Lerner (1998), who looked at U.S. data during the 1976-94 period. Their finding was based on a panel of U.S. state-level data, where variation in capital gains tax rates is very small; in fact their results were driven by a short time-series of federal-level variations in capital gains taxation. Our results are also consistent with the cross-sectional comparison of 'legal and tax friendliness' across European countries in 2002 by Armour and Cummings (2003).

Similarly, our finding that opening a 'new market' for listing entrepreneurial companies has a positive effect on venture investments confirms the positive effect of the number of IPOs found by Cumming, Fleming and Schwienbacher (2003) and of that of the market value of IPOs found by Jeng and Wells (2000). That an increase in public R&D results in an increase in the level of venture investment is consistent with a similar finding by Gompers and Lerner (1998), who used academic R&D expenditure in different U.S. states. Finally, we find that an additional euro of funds raised translates in less than ten cents (three cents) of high-tech (early stage). Moreover, since low-tech and late-stage investments increase proportionately, the estimation in levels confirms that the innovation ratios remain unaffected. The same applies to the effect of the stock of R&D.

5 Conclusion

In this paper we use a panel data analysis to study how public policy can contribute to the creation of active venture capital markets. The results we obtain from a panel of European country-level data over 1988-2001 provide new insights on the effectiveness of alternative policies.

The prevailing policy approach does not receive support from the data. Our results cast more than a passing doubt on the attempt to increase the share of early stage and high-tech venture investments by channeling more funds into venture capital markets, consistent with a 'money chasing deals' situation (Gompers and Lerner (2000)).

Rather, we find that policies which increase the expected return of innovative projects are more successful in altering the composition of venture capital markets towards early stage projects and projects in high-tech industries. A reduction in capital gains taxation raises the share of early stage and high-tech investments. The availability of stock markets targeted at entrepreneurial companies—which provide a lucrative exit channel—also has a positive effects on the innovation ratios, while a reduction in barriers to entrepreneurship leads to an increase in the high-tech ratio. Finally, the stock of public R&D holds no effect on the innovation ratios.

These results suggest a novel interpretation of the 'European Paradox' (European Commission (1994))—the fact that Europe suffers from an inability to turn scientific competence into commercially successful ventures. In the light of our findings, the Paradox seems to be due not to a lack of funding or of attractive technological opportunities, but rather to the difficulties to earn large profits from the creation of new companies, consistent with recent models of entrepreneurship (e.g., Gromb and Scharfstein (2002)).

While we cannot offer a conclusive cost-benefit analysis of alternative policies, our findings on their benefits have implications for policy-makers in countries with emerging venture capital markets. There, the impact of policy early in their development might be particularly important. Even if they reflect the European experience, we believe our results have a clear message: sensible policy should consider a wider set of instruments than simply channeling more funds into venture capital.

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Appendix: Construction of the R&D Capital Stock

The public R&D capital stock (RD_{it}) (measured at the end of period t) in real terms is computed by a perpetual inventory method with a constant rate of depreciation ($\delta = 0.15$). The values of R&D public expenditure in local currency at current prices (R_{it}) are available for each country from 1981 onward from OECD Basic Science and Technology Statistics database. We deflate these data by using a country specific R&D deflator (P_{it}). The benchmark for the first year used in estimation (RD_{i87}) is then calculated by summing up the real expenditures from 1981 to 1987 appropriately depreciated:

$$RD_{i87} = \sum_{t=1981}^{1987} (\frac{R_{it}}{P_{it}})(1-\delta)^{1987-t} \tag{A1}$$

For subsequent years, the standard accumulation equation has been used:

$$RD_{it} = (1-\delta)RD_{it-1} + \frac{R_{it}}{P_{it}}, t = 1988, ..., 2001 \tag{A2}$$

Finally, real R&D capital stock data have been made comparable across countries by applying the 2000 exchange rate with the euro.

Figure 1: Innovation ratios over time

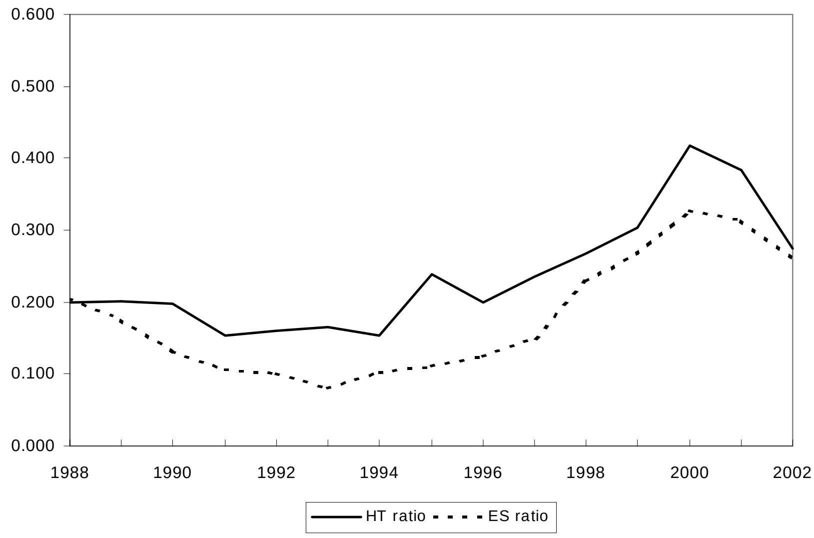
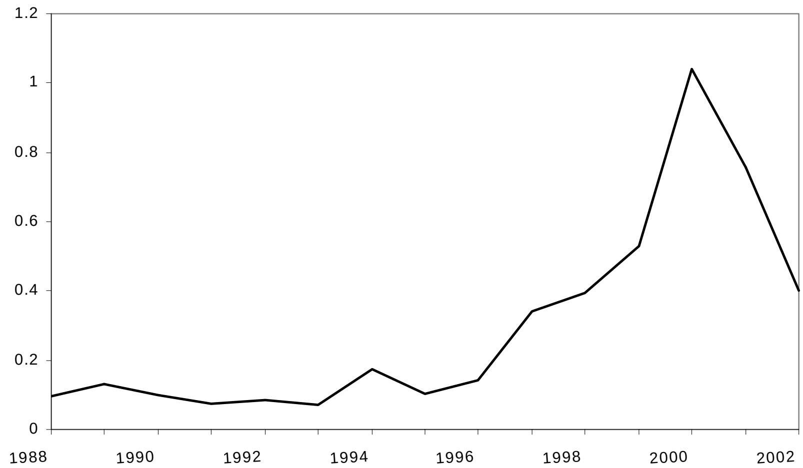
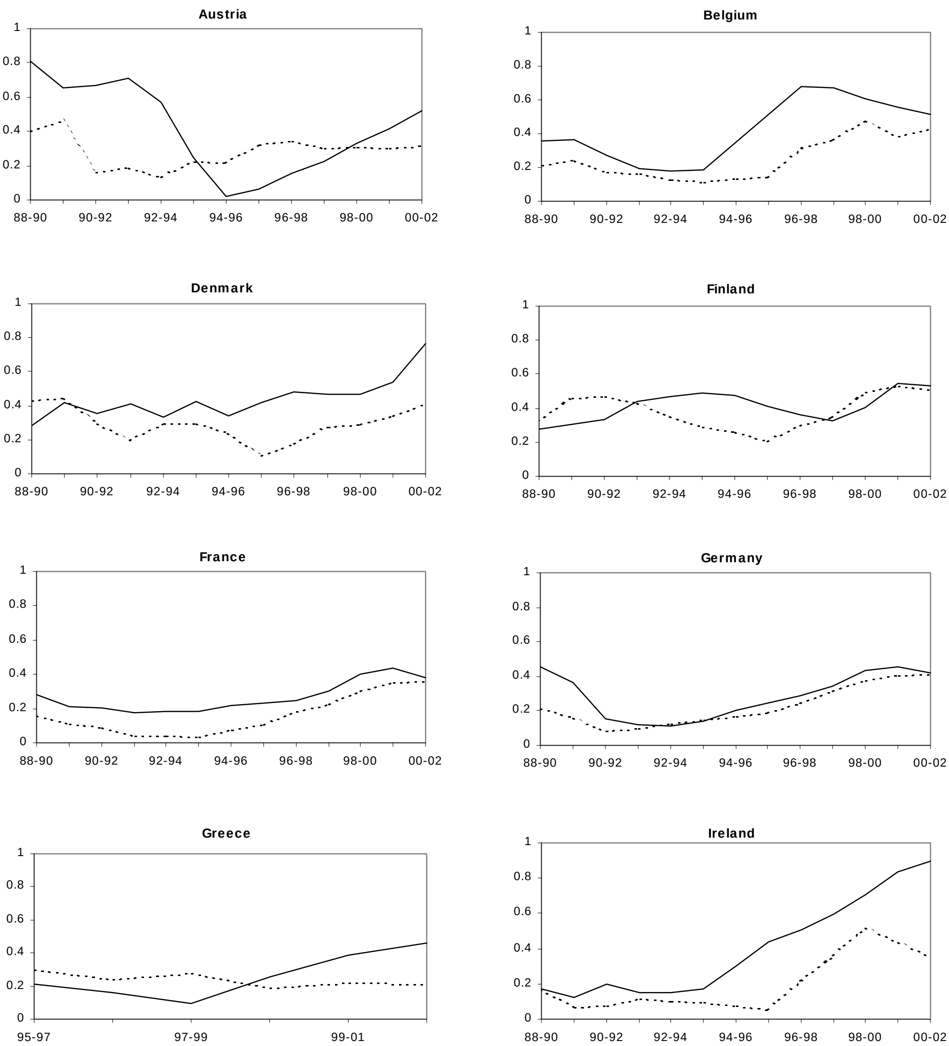


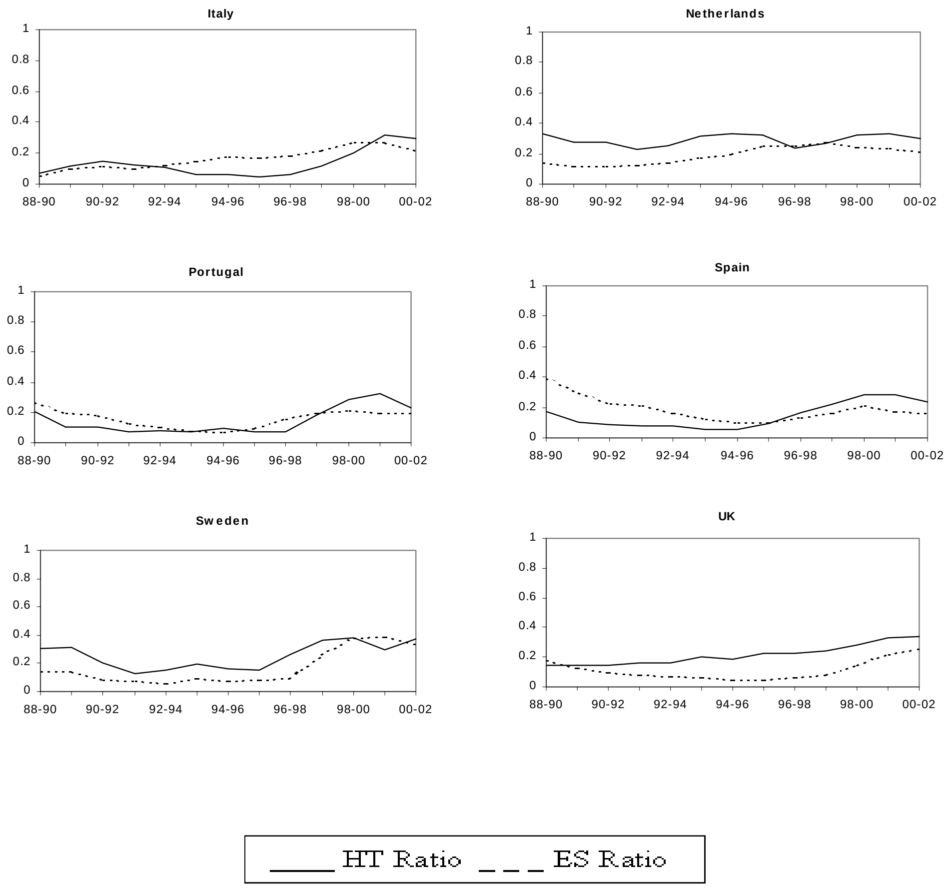
Figure 2: Supply of funds over time



Note: All Ratios are computed for the aggregate of the 14 countries we consider. The ES Ratio is defined as the ratio of ES_t *to* VC_t*. The HT Ratio is defined as the ratio of* HT_t *to* PE_t*. The Supply of Funds is the amount of funds raised by the European private equity industry. It is normalized by the European population.*

Figure 3: Innovation ratios over time by country





Note: For each country, the ES Ratio is defined as the ratio of ES_{it} to VC_{it}, and the HT Ratio is defined as the ratio of HT_{it} to PE_{it}. The figure shows three-year moving averages for each ratio.

Table 1: Variables' definitions

Variable	Description
VENTURE CAPITAL (VC_{it})	total investment in venture private equity, measured in millions of 2000 euros and normalized by the country's population in year t.
BUY-OUTS(BO_{it})	total investment in non-venture private equity, measured in millions of 2000 euros and normalized by the country's population in year t.
PRIVATE EQUITY (PE_{it})	sum of VC_{it} and BO_{it}, measured in millions of 2000 euros and normalized by the country's population in year t.
HIGH-TECH (HT_{it})	total private equity investment in communications, computer related, other electronics related, biotechnology, medical and health related, measured in millions of 2000 euros and normalized by the country's population in year t.
LOW-TECH (LT_{it})	total private equity investment in energy, consumer related, industrial products and services, chemicals, industrial automation, transportation, financial, other services and manufacturing, agriculture, and construction, measured in millions of 2000 euros and normalized by the country's population in year t.
EARLY STAGE (ES_{it})	total investment in early stage venture private equity, measured in millions of 2000 euros and normalized by the country's population in year t.
LATE STAGE (LS_{it})	total investment in late stage venture private equity normalized by the country's population in year t, measured in millions of 2000 euros.
HIGH–TECH RATIO (HTR_{it})	ratio of HT_{it} toPE_{it}.
EARLY–STAGE RATIO (ESR_{it})	ratio of ES_{it} to VC_{it}.
SUPPLY OF FUNDS (SF_{it})	amount of funds raised by the private equity industry, measured in millions of 2000 euros and normalized by the country's population in year t.

Table 1: Variables' definitions (continued)

Variable	Description
CORPORATE CAPITAL GAINS TAX RATE (CGT_{it})	marginal corporate capital gains tax rate.
CORPORATE INCOME TAX RATE (CIT_{it})	marginal tax rate on corporate income.
PERSONAL CAPITAL GAINS TAX RATE ($PCGT_{it}$)	marginal personal capital gains tax rate.
PERSONAL INCOME TAX RATE (PIT_{it})	marginal personal income gains tax rate.
DIFFERENCE IN PERSONAL TAX RATE ($DPIT_{it}$)	difference between (PIT_{it}) and $PCGT_{it}$).
'NEW MARKET' DUMMY(NM_{it})	dummy that takes value 1 if a 'New Market' is available for firms to list; 0 otherwise.
BARRIER ($BARR–HF_{it}$)	value of the 'hiring and firing' labor regulations.
PUBLIC R&D STOCK (RD_{it})	stock of public expenditure in R&D normalized by the country's population in year t.

Note: all observations are for country i at year t.

Table 2: Aggregate descriptive statistics

	Mean	Std. Dev.	Median	5th Perc.	95th Perc.	*Obs*
High-tech ratio	0.294	0.205	0.249	0.049	0.686	*187*
High-tech	0.076	0.132	0.024	0.001	0.411	*187*
Low-tech	0.162	0.273	0.072	0.004	0.653	*187*
Early stage ratio	0.218	0.151	0.187	0.036	0.515	*187*
Early stage	0.034	0.059	0.011	0.001	0.196	*187*
Late stage	0.104	0.128	0.061	0.004	0.350	*187*
Corporate capital gain tax rate	34.8%	6.0%	35.0	25.0	45.0	*187*
Difference in personal tax rate	13.8%	14.2%	8.0	0.0	36.0	*187*
'New Market' dummy	0.257	–	–	–	–	*187*
Barrier	6.299	0.976	6.353	4.657	7.940	*187*
Supply of funds	0.296	0.638	0.093	0.002	1.162	*187*
Public R&D stock	17.720	12.131	18.191	2.256	37.210	*187*

Note: variables are defined in Table 1.

Table 3: Correlations among tax rates

	(CGT_{it})	$(DPIT_{it})$	(CIT_{it})
Corporate capital gains tax rate (CGT_{it})	1.000	–	–
Difference in personal tax rate $(DPIT_{it})$	0.336 (0.000)	1.000	–
Corporate income tax rate (CIT_{it})	0.805 (0.000)	0.422 (0.000)	1.000

Note: variables are defined in Table 1. p-values in patenthesis.

Table 4: Main estimated equations for the high–tech ratio (HTR_{it})

	(i)	*(ii)*	*(iii)*
CGT_{it}	–0.012***	–0.013***	
	(0.003)	(0.003)	
$DPIT_{it}$	0.002		0.003**
	(0.001)		(0.001)
NM_{it}	0.094**	0.097**	0.115**
	(0.044)	(0.045)	(0.047)
$BARR-HF_{it}$	0.036*	0.044**	0.029
	(0.020)	(0.019)	(0.021)
SF_{it}	–0.016	–0.013	–0.024
	(0.027)	(0.027)	(0.028)
RD_{it}	0.002	0.001	0.005
	(0.006)	(0.006)	(0.006)
Time dummies included	Yes	Yes	Yes
F-test on regressors	[0.00]	[0.00]	[0.01]
F-test on time dummies	[0.06]	[0.09]	[0.09]
F-test on individual effects	[0.00]	[0.00]	[0.00]
Number of observations	187	187	187

*Note: variables are defined in Table 1. Standard errors (probability levels) in round (squared) brackets. *, **, and *** denote 0.10, 0.05, and 0.01 significance levels.*

Table 5: Main estimated equations for the early–stage ratio (ESR_{it})

	(i)	*(ii)*	*(iii)*
CGT_{it}	–0.006**	–0.006**	
	(0.002)	(0.002)	
$DPIT_{it}$	0.000		0.001
	(0.001)		(0.001)
NM_{it}	0.091**	0.092**	0.101**
	(0.036)	(0.035)	(0.036)
$BARR-HF_{it}$	-0.014	-0.012	-0.018
	(0.016)	(0.015)	(0.016)
SF_{it}	0.013	0.014	0.009
	(0.021)	(0.021)	(0.022)
RD_{it}	0.003	0.003	0.004
	(0.005)	(0.005)	(0.005)
Time dummies included	Yes	Yes	Yes
F-test on regressors	[0.01]	[0.00]	[0.03]
F-test on time dummies	[0.00]	[0.00]	[0.00]
F-test on individual effects	[0.00]	[0.00]	[0.00]
Number of observations	187	187	187

*Note: variables are defined in Table 1. Standard errors (probability levels) in round (squared) brackets. *, **, and *** denote 0.10, 0.05, and 0.01 significance levels.*

Table 6: Additional estimated equations for the high–tech ratio (HTR_{it})

	(i)	*(ii)*	*(iii)*
CGT_{it}	–0.012***	–0.012***	–0.012***
	(0.003)	(0.003)	(0.003)
$DPIT_{it}$	0.002	0.002	0.002
	(0.002)	(0.001)	(0.001)
NM_{it}	0.082*	0.096**	0.089**
	(0.045)	(0.046)	(0.045)
$BARR-HF_{it}$	0.034*	0.036*	0.033*
	(0.021)	(0.020)	(0.020)
SF_{it}	–0.014	–0.023	–0.027
	(0.038)	(0.032)	(0.029)
SF_{it-1}	-0.006		
	(0.048)		
$SF_{it}*B_{it}$		0.015	
		(0.040)	
$SF_{it}*D_{it}$			–0.235
			(0.215)
RD_{it}	–0.000	0.002	0.001
	(0.006)	(0.006)	(0.006)
Time dummies included	Yes	Yes	Yes
F-test on regressors	[0.00]	[0.00]	[0.00]
F-test on time dummies	[0.09]	[0.07]	[0.05]
F-test on individual effects	[0.00]	[0.00]	[0.00]
Number of observations	171	187	187

*Note: variables are defined in Table 1, except B_{it}, which is a dummy that takes value 0 in the years between 1997 and 2000, and 1 otherwise; and D_{it}, which is a dummy variable that takes value 1 for those countries whose venture capital market larger than the median European market in 1988 and 0 otherwise. Standard errors (probability levels) in round (squared) brackets. *, **, and *** denote 0.10, 0.05, and 0.01 significance levels.*

Table 7: Additional estimated equations for the early–stage ratio ($\mathbf{ESR}_{it}$)

	(i)	*(ii)*	*(iii)*
CGT_{it}	–0.008***	–0.006**	–0.006**
	(0.002)	(0.002)	(0.002)
$DPIT_{it}$	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)
NM_{it}	0.088***	0.095***	0.090**
	(0.033)	(0.036)	(0.036)
$BARR-HF_{it}$	-0.011	-0.015	-0.015
	(0.015)	(0.016)	(0.016)
SF_{it}	0.018	0.001	0.010
	(0.028)	(0.025)	(0.023)
SF_{it-1}	-0.001		
	(0.035)		
$SF_{it}*B_{it}$		0.028	
		(0.032)	
$SF_{it}*D_{it}$			–0.057
			(0.170)
$BARR-HF_{it}$	-0.011	-0.015	-0.015
	(0.015)	(0.016)	(0.016)
RD_{it}	-0.001	0.003	0.003
	(0.005)	(0.005)	(0.005)
Time dummies included	Yes	Yes	Yes
F-test on regressors	[0.00]	[0.01]	[0.01]
F-test on time dummies	[0.00]	[0.00]	[0.00]
F-test on individual effects	[0.00]	[0.00]	[0.00]
Number of observations	171	187	187

*Note: variables are defined in Table 1, except B_{it}, which is a dummy that takes value 0 in the years between 1997 and 2000, and 1 otherwise; and D_{it}, which is a dummy variable that takes value 1 for those countries whose venture capital market larger than the median European market in 1988 and 0 otherwise. Standard errors (probability levels) in round (squared) brackets. *, **, and *** denote 0.10, 0.05, and 0.01 significance levels.*

Table 8: Estimated level equations for high-tech and low-tech (HT_{it} and LT_{it})

	HT_{it}	LT_{it}
CGT_{it}	–0.002*	0.007**
	(0.001)	(0.003)
$DPIT_{it}$	0.000	0.001
	(0.001)	(0.001)
NM_{it}	0.062***	0.070*
	(0.016)	(0.042)
$BARR-HF_{it}$	0.007	0.028
	(0.007)	(0.019)
SF_{it}	0.095***	0.187***
	(0.010)	(0.025)
RD_{it}	0.012***	0.033***
	(0.002)	(0.006)
Time dummies included	Yes	Yes
F-test on regressors	[0.00]	[0.00]
F-test on time dummies	[0.00]	[0.67]
F-test on individual effects	[0.00]	[0.00]
Number of observations	187	187

*Note: variables are defined in Table 1. Standard errors (probability levels) in round (squared) brackets. *, **, and *** denote 0.10, 0.05, and 0.01 significance levels.*

Table 9: Estimated level equations for early stage and late stage (ES_{it} and LS_{it})

	ES_{it}	LS_{it}
CGT_{it}	–0.001*	0.002
	(0.001)	(0.001)
$DPIT_{it}$	0.000	-0.000
	(0.000)	(0.001)
NM_{it}	0.030***	0.037*
	(0.010)	(0.021)
$BARR-HF_{it}$	0.003	0.025***
	(0.004)	(0.009)
SF_{it}	0.024***	0.062***
	(0.006)	(0.012)
RD_{it}	0.006***	0.012***
	(0.001)	(0.003)
Time dummies included	Yes	Yes
F-test on regressors	[0.00]	[0.00]
F-test on time dummies	[0.00]	[0.22]
F-test on individual effects	[0.00]	[0.00]
Number of observations	187	187

*Note: variables are defined in Table 1. Standard errors (probability levels) in round (squared) brackets. *, **, and *** denote 0.10, 0.05, and 0.01 significance levels.*